

Remarks

Claims 1-32 and 34 are pending. Claims 1-4, 6, 32 and 34 are rejected. Claim 5 has been allowed. Claims 1, 17, 18, 19, 27 & 34 are amended for clarity. Re-examination and reconsideration are requested.

The subheadings below conform to those used in the Office Action to which this document responds.

Drawings

The Examiner objects to the drawings under 37 C.F.R. § 1.8(a). He requires that the feature claimed in claims 8 and 18 which calls for “the input and output discs [are] of different sizes” must be shown or the feature(s) cancelled from the claim(s).

It will be appreciated that the drawings are not necessarily to scale. They merely depict various aspects of the invention. There is no requirement that the drawings be as precise as an engineering blueprint. Size differences between the input discs 18, 20 and output disc 22 can be inferred from the drawings. *See, e.g.*, Fig. 2.

If there is any doubt about the size differences, the reader may turn to the Specification at page 10, lines 5-8: “. . . and tangential to the periphery of the largest of the discs (in this embodiment the diameters of the two input discs 18, 20 and of the output disc 22 are equal) . . .”. This clearly provides basis for a claim limitation that the sizes of the discs in some embodiments may be unequal.

To require Applicants to provide scale drawings is neither necessary nor required under the Rules of Patent Practice. The Examiner is respectfully asked to rescind his objection to the drawings.

Claim Rejections - 35 U.S.C. § 112

Claim 32 stands rejected under 35 U.S.C. § 112 ¶ 2 as being indefinite. The Examiner takes the view that in [independent] claim 32, the limitation “the larger of the input disc and output disc” lacks proper antecedent basis.

Support for this limitation lies in the Specification. Claim 8 as filed is part of the original Specification. It refers to “the periphery of the larger of the input disc and output disc”. Similarly, for claim 18.

Applicants respectfully submit that this language differentiates between the size of an input disc on the one hand and the output disc on the other hand.

For these reasons, Applicants respectfully asks the Examiner to reconsider and rescind the rejection of claim 35 under 35 U.S.C. § 112.

Claim Rejections - 35 U.S.C. § 102

Claims 1, 2, 6-15, 17-25, 27-29 & 34 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Imanishi (JP 7-280055).

Claims 1, 18 & 34 have been amended to more particularly emphasize the distinction between the disclosure of Imanishi and the present invention as defined in those claims.

Claims 1, 18 and 34 specify that the pivoting joint is a “single pivoting joint whereby each roller carriage is capable of three degrees of rotational movement about the pivoting joint”.

This Amendment makes clear that each roller carriage is capable of three degrees of rotation and that the rotational freedom is about the pivoting joint, so providing a full, universal range of rotation. The Amendment therefore makes clear that the range of movement - - that is, three degrees of freedom - - is an essential feature of the invention.

In the Specification, the pivoting joint is referred to at page 8, lines 8, 15 and 21; at page 9, line 7; and is shown in the drawings as reference numeral 47 and in the drawings in Figures 2 to 5 and 7 to 9.

As illustrated in the drawings, the joint is the single pivoting joint by which the roller carriage may rotate about several axes. By way of example a “Rose” bearing is given as an illustrative example of a suitable pivoting joint 47. The skilled person is entirely familiar with a Rose bearing in that it offers the rotational degrees of freedom or universal movement as recited in the amended claims. The amendment is therefore fully supported by the description and drawings.

The pivoting joint 47 in each case is attached to the roller carriage 34 (page 9, line 7). The roller carriage together with the roller 33 which is mounted on a stub axle 35 in the carriage constitutes the roller assembly (page 6, line 15) in each case. The pivoting joint 47 is also connected to a lever 44. The arrangement described in the Specification enables the roller carriages to freely rotate and to tilt and pivot about three orthogonal axes about the single pivoting joint, as is apparent to the skilled person upon reading the Specification. The movement of the rotating lever to which the pivoting joint is attached enables the roller carriage and hence the roller to move with the requisite multiple degrees of freedom.

Imanishi does not permit this range and freedom of movement. Moreover, Imanishi does not disclose a single pivoting joint which enables multiple degrees of freedom for the roller about a single joint as in the present invention.

In particular, Imanishi discloses a power roller 8 mounted in a trunnion 6 with two pivots 5 defining an axis. A trunnion may be defined as a pin or pivot forming one of a pair on which something is supported for example a supporting cylindrical projection on each side of a cannon or mortar. In other words, something mounted in a trunnion tilts within a fixed plane of movement. The roller 8 in Imanishi can only tilt about the axis defined by the two pivot shafts 5 in the fixed housing 20. The trunnion 6 is activated by the member 39 to move by a small amount linearly along the axis of the trunnion. The member 39 is connected to

“L” shaped lever 44, which is rotatable, and translates the rotational movement of lever 44 into the linear movement of the trunnion 6.

In summary, the roller in Imanishi may only tilt about a single axis and the trunnion is moveable along that axis to a certain degree. There are no other degrees of freedom of rotation for the roller intended in Imanishi. The member 39 does not provide a single pivot joint about which the roller carriage or trunnion may rotate with multiple degrees of freedom. Imanishi therefore does not disclose the claimed invention.

As such, independent claims 1, 18 and 34 as well as independent claims 5 (indicated as allowable) and 32 are novel over this art. The dependent claims by virtue of their dependency on novel independent claims are also novel over Imanishi.

Claim Rejections - 35 U.S.C. § 103

Claims 3-4 & 28-31 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Imanishi (JP 7-280055).

The Examiner concedes that “Imanishi does not disclose a plurality of levers pivotally mounted about a first axis . . . [and that . . .] Imanishi teaches friction rollers disposed in a single toroidal cavity.” The Examiner’s position is that “it was notoriously well known in the art to configure friction rollers in two separate toroidal cavities, wherein the actuators associated with the first toroidal cavity are aligned with the actuators of the second toroidal cavity. It would have been obvious to one with ordinary skill in the art at the time the invention was made to provide the plurality of levers pivotally mounted about a first axis to actuate a plurality of friction rollers disposed in separate toroidal cavities . . .”. Office Action ¶ 7.

Claim 3 requires the limitations of claim 1. The structural differences between claim 3/1 and Imanishi were discussed above, and are incorporated here by reference. These structural features enable functional attributes from which the cited reference teaches away, for at least the following reasons.

The range of freedom of the roller carriages afforded by the single pivoting joint in the present invention enables the rollers to adjust to an equilibrium position between the input and output discs. A reaction force is transmitted to the roller through the lever and the pivoting joint and the roller carriage is able to rotate freely with respect to the actuator lever. The single pivot joint allows the roller to find its own equilibrium tilt angle for any given lever position, whilst allowing the force arising from the pressure within the roller control pistons to be transmitted from lever to roller via the joint. The particular arrangement by which the roller carriages are mounted in the present invention affords multiple degrees of rotational freedom to the roller carriages and allows the variator to be controlled by the reaction force and the speed ratio of the input and output discs.

This arrangement provides significant practical benefits as regards durability, efficiency and accommodation of manufacturing tolerances, an important consideration in producing a compact variator economically. The lateral (or yaw) rotational degree of freedom allows the roller to accommodate axial movement in the input and output discs which may arise due to effects known in the art such as “variator mainshaft extension” and “disc deflection”. Furthermore, the roller may accommodate geometrical imperfections or deficiencies in the toroidal profile. The practical advantage of these benefits is that, in a simple mechanical package, all the rollers receive similar loads imparted from their respective hydraulic pistons (via their respective lever and pivoting joint), as well as similar normal contact loads. Each roller therefore experiences a similar ratio of contact shearing load to contact a normal load (“traction coefficient”), resulting in advantageous durability and efficiency.

Thus, there are significant differences in function, way and result between claims 3/1 and Imanishi.

For at least these reasons, claim 3 cannot be said to be rendered obvious by Imanishi. Similarly, for claim 4, which includes the limitations of claim 3.

Claim 28 includes the limitations of claim 18, which differs from the cited reference for the reasons noted above. For at least those reasons, claim 28 cannot be said to be rendered obvious by Imanishi. Similarly, for dependent claims 29-31.

Claim 16 is rejected is rejected under 35 U.S.C. § 103(a) as being unpatentable over Imanishi (JP 7-280055) in view of Yamamoto (USP 5,971,886). The Examiner concedes that Imanishi does not disclose the cylinders disposed in a common cylinder block, which the Examiner states is a teaching that is provided by Yamamoto.

Claim 16 includes the limitations of claims 13 and 1. The structural differences and their functional attributes in relation to Imanishi were discussed earlier. It is Applicants' view that there is no suggestion in either reference for a combination of the type proposed by the Examiner. But even made, the combination would not result in the invention as claimed for the reasons discussed earlier.

Allowable Subject Matter

Applicants note with appreciation that claim 5 is allowed and that claim 32 would be allowable if rewritten to overcome the rejection under 35 U.S.C. § 112, ¶ 2. The earlier discussion of this rejection is incorporated hereby by reference.

All formal and substantive requirements for patentability appear now to have been met. A Notice of Allowance is earnestly solicited.

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Respectfully submitted,
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